

# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

# PCT

To:  
FISH & RICHARDSON P.C.  
Attn. Thompson, Dwight U.  
P.O. Box 1022  
Minneapolis MN 55440-1022  
UNITED STATES OF AMERICA

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT AND  
THE WRITTEN OPINION OF THE INTERNATIONAL  
SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing (day/month/year) 06/04/2006	
Applicant's or agent's file reference 09991-182WO1	<b>FOR FURTHER ACTION</b> See paragraphs 1 and 4 below
International application No. PCT/US2005/038743	International filing date (day/month/year) 26/10/2005
Applicant  DIMATIX, INC.	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

**Where?** Directly to the International Bureau of WIPO, 34 chemin des Colombettes  
1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

**For more detailed instructions,** see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.
3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
- ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.
- ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

**4. Reminders**


Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the International Searching Authority  European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  Lucia Ertl
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## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the *PCT Applicant's Guide*, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report and the written opinion of the International Searching Authority, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only (see *PCT Applicant's Guide*, Volume I/A, Annexes B1 and B2).

The attention of the applicant is drawn to the fact that amendments to the claims under Article 19 are not allowed where the International Searching Authority has declared, under Article 17(2), that no international search report would be established (see *PCT Applicant's Guide*, Volume I/A, paragraph 296).

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Section 205(b)).

**The amendments must be made in the language in which the international application is to be published.**

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

**The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.**

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference  09991-182W01	<b>FOR FURTHER ACTION</b>  see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No.  PCT/US2005/038743	International filing date (day/month/year)  26/10/2005	(Earliest) Priority Date (day/month/year)  03/11/2004
Applicant  DIMATIX, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed  
☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☐ the text is approved as submitted by the applicant  
☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 8a  
☒ as suggested by the applicant  
☐ as selected by this Authority, because the applicant failed to suggest a figure  
☐ as selected by this Authority, because this figure better characterizes the invention  
b. ☐ none of the figures is to be published with the abstract

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2005/038743

### Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

Apparatus including a plurality of droplet ejection devices, an electric source and a controller (20). Each droplet ejection device (860) includes switches ( $Sc1, Sc2, \dots ScN$ ) connected in parallel to a piezoelectric actuator (c). Each switch includes an input terminal to connect to an input waveform ( $Xv$ ) signal, an output terminal to connect to the piezoelectric actuator, a control signal terminal to control a connection of the switch with a control signal, and a resistance ( $Rc1, Rc2, \dots RcN$ ) between the input terminal and output terminal. The apparatus has a waveform table with information to distribute the input waveform signal to an input of each of the droplet ejection devices. The waveform signal table includes waveform signal information for a step pulse, a sawtooth waveform, and/or a combination of two or more waveform patterns.

# INTERNATIONAL SEARCH REPORT

International application No

PCT/US2005/038743

## A. CLASSIFICATION OF SUBJECT MATTER

B41J2/045

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	EP 0 876 915 A (SEIKO EPSON CORPORATION) 11 November 1998 (1998-11-11) column 1, line 45 - column 2, line 26 figures 13a, 13b -----	1-27
X	US 6 517 195 B1 (KOEDA HIROSHI) 11 February 2003 (2003-02-11) column 6, line 13 - column 7, line 15 figures 5a-5d -----	1-27

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

30 March 2006

Date of mailing of the international search report

06/04/2006

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.  
Fax: (+31-70) 340-3016

Authorized officer

Bridge, S

**INTERNATIONAL SEARCH REPORT***Information on patent family members*

International application No

PCT/US2005/038743

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0876915	A	11-11-1998	DE 69819069 D1	27-11-2003
			DE 69819069 T2	22-07-2004
			ES 2210672 T3	01-07-2004
			JP 2940542 B2	25-08-1999
			JP 11020203 A	26-01-1999
			US 6312076 B1	06-11-2001
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US 6517195	B1	11-02-2003	WO 9847710 A1	29-10-1998
			JP 3479979 B2	15-12-2003
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# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

## PCT

see form PCT/ISA/220

### WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/US2005/038743

International filing date (day/month/year)  
26.10.2005

Priority date (day/month/year)  
03.11.2004

International Patent Classification (IPC) or both national classification and IPC  
INV. B41J2/045

Applicant  
DIMATIX, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized Officer

Bridge, S

Telephone No. +49 89 2399-2837



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2005/038743

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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ in written format
    - ☐ in computer readable form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in computer readable form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2005/038743

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**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	12-22, 27
	No: Claims	1-11, 23-26
Inventive step (IS)	Yes: Claims	
	No: Claims	1-27
Industrial applicability (IA)	Yes: Claims	1-27
	No: Claims	

2. Citations and explanations

**see separate sheet**

**V Statement concerning novelty, inventive step & industrial applicability**

- 1 Claim 19 includes all features of claim 24 and should be recast as a dependent claim, depending on claim 24 (Guidelines C-III 3.5, Rule 6.4(a) PCT). The claims must then be renumbered accordingly.
- 2 Document D1 = EP-A-0 876 915 (see especially column 1 line 45 to column 2 line 26, figures 13a, 13b) discloses a system to control printing of an inkjet printer, the system comprising:
  - a filter circuit (figure 13a) to filter high-frequency signals in input waveform signals, wherein the filter circuit is configured to provide stable firing waveform signals for an actuator for ink droplet ejection, the filter circuit comprising:
    - an effective resistance formed from a plurality of resistors (R1-R6) electrically connected in parallel, wherein a first end of the parallel connection is connected to an input waveform terminal (V) and a second end of the parallel connection is connected to the actuator (C) for ink droplet ejection; and a plurality of switches, wherein at least one switch is configured to connect at least one of the plurality of resistors (R1-R6) in parallel with another resistor (R1-R6), and wherein each switch is configured to be electrically connected in series with a resistor (R1-R6); and a controller to control which of the plurality of switches are electrically connected to determine a resistance value for the effective resistance, wherein a frequency response of the filter circuit is related to the effective resistance and a capacitance of the actuator.
- 2.1 Similarly, D1 (see especially column 1 line 45 to column 2 line 26, figures 13a, 13b) also discloses a method to control a response of a droplet ejection device comprising a plurality of switches (figure 13a) and a piezoelectric actuator (C), the method comprising: connecting the plurality of switches to the piezoelectric actuator (C), wherein each switch comprises an input terminal to connect to a waveform signal (V), an output terminal to connect to the piezoelectric actuator (C), a control signal terminal to control a connection of the switch with a control signal ("switching by transistor"), and a resistance (R1-R6) between the input terminal and output terminal; selecting a waveform signal to apply to the input terminal of each of the plurality of switches; applying the selected waveform signal on the input terminal of each of the plurality of switches, wherein the each of the plurality of switches are connected at a common output terminal at the piezoelectric actuator (C); and controlling the control

signal terminal of each switch with the control signal.

- 2.2 The subject matter of claims 1 and 24 does not differ from the above. Claims 1 and 24 are not new.

Therefore, the subject matter of independent claims 1 and 24 does not satisfy the criteria set forth in Articles 33(2) PCT.

- 3 D2 = US-A-6 517 195 (see especially column 6 line 13 to column 7 line 15, figures 5a-5d) discloses a method and apparatus from which the subject matter of claims 1 and 24 only differ in that the capacitive actuator is of an electrostatic type instead of a piezoelectric type. Such a minor change comes within the normal practice of the art of the skilled person. The invention therefore consists merely in the use of technique known from D2 in a closely analogous situation (Guidelines C-IV, Annex 1, 1.1(v)). Therefore, the subject matter of independent claims 1 and 24 does not satisfy the criteria set forth in Articles 33(3) PCT.

- 4 Furthermore, D1 (see especially column 1 lines 20 - 44) concerns a piezoelectric ink jet printer and therefore discloses an electrically actuated displacement device configured to move between a displaced position and an undisplaced position to change the volume of a fluid chamber as a charge associated with the piezoelectric actuator changes between an actuated condition and an unactuated condition, and wherein the fluid chamber comprises a volume and an ejection nozzle.

The subject matter of claim 2 does not differ from the above. Claim 2 is not new.

- 4.1 Furthermore, in D1 (see especially figure 13a) the waveform signal is selected for the input terminal of at least two switches; the plurality of switches are connected in parallel; the piezoelectric actuator comprises a capacitance, each switch comprises a resistor.
- 4.2 In D1 (see especially figure 13a), the resistance from each of the plurality of switches and the capacitance of the piezoelectric actuator are arranged to form a low-pass filter circuit, which will necessarily filter high-frequency harmonics with the low-pass filter circuit to provide firing waveforms at the actuator that are consistent for a same pattern of input waveform signal.
- 4.3 The piezoelectric ink jet printer of D1 further comprising controlling the control signal terminal of each of the one or more of the switches of the low-pass filter circuit to form an effective resistance for the low-pass circuit that is based on one or more

resistors connected in parallel and the effective resistance comprises a parallel combination of switches that are active in the low-pass filter circuit, wherein an active switch comprises a switch with a high voltage on the control signal terminal of the switch and the switch is electrically connected.

- 4.4 The circuit of D1 further comprising varying a frequency response of the low-pass filter circuit by varying a selection of activated switches.
- 4.5 D1 (see especially figure 13b) discloses that the waveform signal comprises any of a step pulse, a sawtooth waveform, and a combination of two or more waveform patterns.
- 4.6 The subject matter of claims 2-11, 25, 26 does not differ from the above. Claims 2-11, 25, 26 are not new.

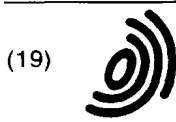
Therefore, the subject matter of dependent claims 2-11, 25, 26 does not satisfy the criteria set forth in Articles 33(2) PCT.

- 5 The additional features of dependent claims 12-22, 27 only concern minor modifications, which must be regarded as normal design steps for the person skilled in the art. A combination of any of the features of dependent claim 12-22, 27 respectively with claims 1 and 24 would not appear to add anything inventive (Article 33(3) PCT) and therefore does not seem to form a suitable basis for a new claim.

In particular :

- D1 (column 2 lines 17-26) suggests to compensate for inkjet direction variability between ink nozzles, increase print control, produce different responses, and produce different spot sizes for each print job (cf claims 13 and 14);
- D1 (see especially column 1 lines 49-50) discloses that the circuit is configured to charge a capacitance of the actuator, and wherein the circuit is further configured to discharge a capacitance of the actuator (cf claim 27).

Therefore, the subject matter of dependent claims 12-22, 27 does not satisfy the criteria set forth in Articles 33(3) PCT.



(19)

Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 0 876 915 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
11.11.1998 Bulletin 1998/46

(51) Int Cl.<sup>6</sup> **B41J 2/045**

(21) Application number: **98303543.7**

(22) Date of filing: **06.05.1998**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

(72) Inventors:  
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Suwa-shi, Nagano (JP)  
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Suwa-shi Nagano (JP)

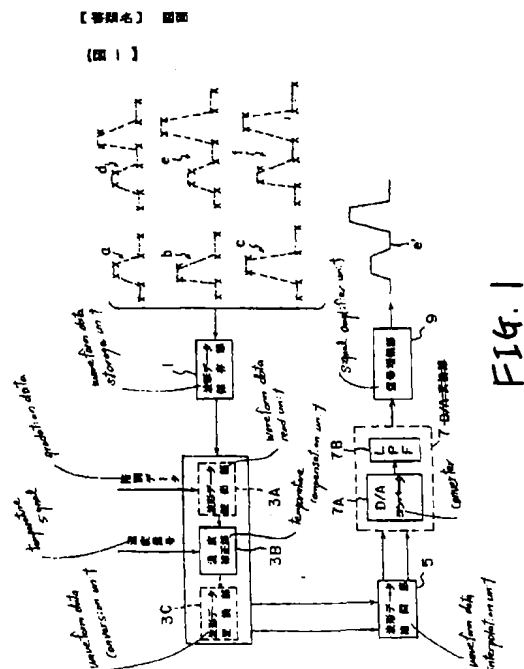
(30) Priority: **07.05.1997 JP 117322/97**  
**15.04.1998 JP 104970/98**

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(71) Applicant: **SEIKO EPSON CORPORATION**  
**Shinjuku-ku, Tokyo (JP)**

(54) **Driving waveform generating device and method for ink-jet recording head**

(57) A driving waveform generating device and method comprises the steps of retaining data on absolute coordinate values in a waveform data storage unit 1 as data at a plurality of points in a plurality of driving waveforms a - f at a predetermined temperature, reading the data on the plurality of point in a desired driving waveform *g* from a waveform data read unit 3A on the basis of gradation data, correcting the difference between the environmental temperature during the printing operation and the aforesaid predetermined temperature in a temperature compensation unit 3B, converting data on the corrected absolute coordinate value to data on the relative coordinate value in a waveform data conversion unit 3C, interpolating the point-to-point value by means of a waveform data interpolation unit 5, subjecting the interpolated the data on the driving waveform to analog conversion by means of a D/A conversion unit 7, amplifying the analog signal in a signal amplifier unit 9, and outputting the amplified signal.

**EP 0 876 915 A2**



US006517195B1

(12) **United States Patent**  
**Koeda**

(10) **Patent No.:** **US 6,517,195 B1**  
(45) **Date of Patent:** **\*Feb. 11, 2003**

(54) **INK JET HEAD WITH AN INTEGRATED  
CHARGING CONTROL CIRCUIT**

(75) Inventor: **Hiroshi Koeda**, Fujimi-machi (JP)

(73) Assignee: **Seiko Epson Corporation**, Tokyo (JP)

(\*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/202,488**

(22) PCT Filed: **Apr. 17, 1998**

(86) PCT No.: **PCT/JP98/01757**

§ 371 (c)(1),

(2), (4) Date: **Mar. 18, 1999**

(87) PCT Pub. No.: **WO98/47710**

PCT Pub. Date: **Oct. 29, 1998**

(30) **Foreign Application Priority Data**

Apr. 18, 1997 (JP) ..... 9-102305

(51) Int. Cl.<sup>7</sup> ..... **B41J 2/045**

(52) U.S. Cl. .... **347/68**

(58) Field of Search ..... 347/54, 50, 9-11,  
347/68, 69, 70, 71, 20, 59, 58, 57, 47,  
40; 361/700; 399/261; 29/890.1

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,563,634 A	*	10/1996	Fujii et al.	347/54
5,668,579 A	*	9/1997	Fujii et al.	347/54
5,691,752 A	*	11/1997	Moynihan et al.	347/68
5,757,402 A	*	5/1998	Günther et al.	347/68 X
5,818,473 A	*	10/1998	Fujii et al.	347/54 X
5,975,668 A	*	11/1999	Fujii et al.	347/54 X
5,984,447 A	*	11/1999	Ohashi	347/71 X

**FOREIGN PATENT DOCUMENTS**

EP	580 283	1/1994
JP	5-31898	2/1993
JP	6-71882	3/1994
JP	7-266558	10/1994

**OTHER PUBLICATIONS**

Fink, D.G. and Christiansen, D. "Integrated-Circuit Design." In: Electronics Engineers' Handbook—Third Edition (New York, McGraw Hill, 1989) pp. 8-45-8-106. TK7825.E34.\*

\* cited by examiner

Primary Examiner—Raquel Yvette Gordon

Assistant Examiner—Charlene Dickens

(57) **ABSTRACT**

In an ink jet head for performing charging and discharging between diaphragms and electrodes to transform the diaphragms to thereby eject ink drops from nozzle holes, a control circuit (60) of this ink jet head is constituted by an integrated circuit which is provided on a nozzle plate (300), a diaphragm substrate (200) or an electrode glass substrate (100) of an ink jet head chip (7).

**15 Claims, 11 Drawing Sheets**

